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Effect of Annealing and Stresses on the Shear Modulus of Solid Helium[1] ALEXANDER SYSHCHENKO, JAMES DAY, JOHN BEAMISH, University of Alberta — Recent measurements suggest that defects are crucial to "supersolid" behavior. Dislocations produced during crystal growth or by plastic deformation can have dramatic effects on a solid's mechanical properties. We have made pressure/flow and elastic/acoustic measurements on solid helium and have studied the effects of annealing near melting and of applying large stresses at low temperatures. Pressure gradients are greatly reduced by annealing, but only at temperatures quite close to melting. In our elastic measurements, we observed a large stiffening of the shear modulus in the same temperature range where decoupling was observed in torsional oscillators, behavior which can be understood in terms of the response of mobile dislocations above 100 mK. Annealing usually raises the high temperature shear modulus but leaves the low temperature modulus unchanged, as expected if annealing eliminates some dislocations. Applying large stresses further increases the high temperature modulus, but these changes are reversed by heating above 0.5 K, suggesting that the defects introduced by stressing the crystal are much easier to anneal than the dislocations produced during growth.

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